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ASPECTS OF HYDROBIOLOGY OF LAKE ONA IN SOUTHERN NIGERIA 1: FISH FAUNA

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A study was conducted at three stations on Lake Ona between August 2001 and July 2003, to provide baseline information on the community structure, species composition, abundance, diversity and spatial distribution of the fish fauna of the lake. Fish samples were collected fortnightly from the stations between 06.00-07.30 hrs and 17.00-18.30 hrs on sampling days. A complement of both surface and bottom fshing gear were used to catch fish. The total catch was 1,394 individuals with a biomass of 184 kg. The catch was made up of 52 species, 33 genera and 22 families. The dominant species in terms of number and biomass were Mochokidae *and* Osteoglosside *respectively. Analysis of variance and LSD showed fish biomass at stations I and V to be significantly different from Station III ($P<0.05$). Number of fish caught in stations III and V were significantly different from Station I ($P<0.05$) but were not significantly different from each other ($P>0.05$).Station I had the lowest number of taxa and individuals caught, but had the highest diversity and evenness. With good management, the fisheries resource of the lake can be profitably exploited.*

INTRODUCTION

Fish is an important source of high quality protein that represents at least 55% of the protein intake sources of Nigerian citizens, a factor that makes it a key ingredient on the global menu. Fish is equally an important basis for livelihoods worldwide and a vital factor in the global environmental balance. These follow from man's exploitative and other anthropogenic activities that impact negatively on fish through over-exploitation and on its environment through ecosystem degradation.

Globally, there is a corresponding rise in the interest of researchers on the maintenance, sustenance and preservation of genetic diversity of fish as an essential ecological resource and life support system. Some studies have been conducted on the water chemistry, the biology, distribution, abundance and trends in the establishment of some fish species in some lakes, such as Asejire, Chad and Kainji in Nigeria, by Imevbore (1970), Egborge (1977), Otobo (1977), and Zelibe (1982) in Eleiyele and Fagade (1983).

Lake Ona is a natural freshwater lake in the Oshimili South Local Government Area of Delta State in Southern Nigeria. Like other freshwater bodies in Nigeria, Lake Ona has been undergoing steady exploitation over the years by artisanal fishermen, whose only objective is to catch fish for commercial purposes. No scientific study has been carried out on this lake. This paper, the first of a series on this important lake, is geared towards providing a comprehensive baseline information on the hydrology, community structure, species composition, abundance, diversity and spatial distribution of the fish fauna. In addition, it aims at providing a scientific background on the potential biological resources of the lake for future exploitation.

MATERIALS AND METHODS

The Study Area.

Lake Ona is a tropical freshwater lake, west of the Niger River, having its source from the Utto spring. It is located eight kilometers from Asaba, Nigeria, lying on latitude $6^{o}41^{'}$E and longitude $6^{o}15^{'}$N of the equator (Figure 1). The lake has a length of 2,250 m, an area of 516,197 m^2 and a volume of 4,413,804 m^3.

Topography and Vegetation

Lake Ona is situated in the Asaba–Ogwashi rock formation and has a gentle slope from its banks that permits inflow of surface runoff and organic matter derived from the surrounding vegetation. This load contributes to the allochthonous input of the lake. The substratum is made up of a deep layer of clay and an admixture of silt and decomposing organic matter. The lake is devoid of thick tree canopy but it is dominated by floating aquatic macrophytes viz *Salvinia nymphellula* Desv., *Nymphaea lotus* Linn., present mostly in the back waters found floating on the water surface are *Azolla pinneta,* R.Br. Var. Africana (Desv) and *Pistia straitiotes*. Fringing the shoreline, is a dense population of *Panicum subalbidium*, Kunth. *Paspalum scrobiculatum*, Linn., and *Diplazioum sammati*, Kahn.

Study Stations

In the wet season Lake Ona appears as a common sheet of water but it is compartmentalized into the three distinct sections of Ona-ododo, Ogbu and Obabala, with Ogbu and Ona-ododo being the largest and smallest. Five sites were established in the course of the study and were designated Stations I, II, III, IV and V. Stations I, III and V were located at Ona-ododo, Ogbu and Obabala

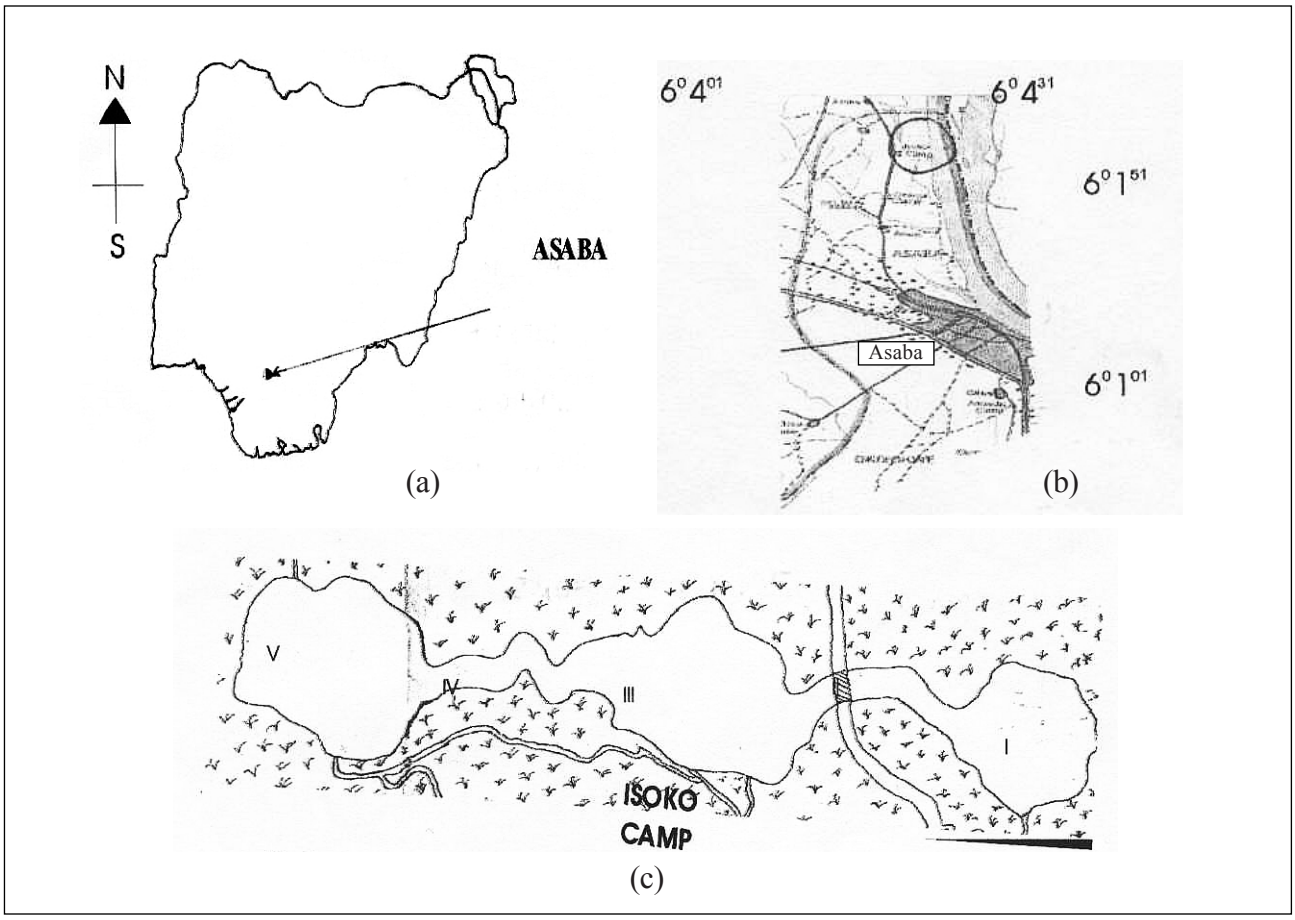

Figure 1a, 1b and 1c. Map of Nigeria showing Asaba, Study Area, and Stations on Lake Ona.

respectively. Station II is the link between Stations I and III, while the link between Stations III and V is Station IV. The morphometric features of the lake are presented in Table 1.

Sampling of Fish

Fish samples used for the study were collected at fortnightly intervals between August 2001 and July 2003 from the three stations designated I, III and V, which are the mainchannels of the lake. For the purpose of sampling one fisherman and a boatman were engaged for each station. At each station, three bottom set and three surface set gill nets of mesh sizes 1.0, 3.0 and 5.0 cm were used for sampling. Each net had a length of 25.0 m and a depth of 3.0 m. In addition to these nets, one segmented cast net with pockets of stretched mesh size 6.4 cm was used at each of the stations.

To take care of the bottom dwellers, five sets each of fish baskets, locally called manly, and the non-return value traps were used at each station. There was also a set of long-lines of length 35.0 m which ran along the edges of the fringing vegetation of the three stations. In the dry season months, fish aggregating devices (FAD) and fences were used to aggregate and catch fish. The fishing gear used was tended twice on sampling days between 06.00hr-7.30hr and 17.00hr-18.30hr.

All fish samples caught were washed, packaged in iced plastic buckets and transported to the laboratory, where they were sorted, counted, and all measurements (total length, standard length and weight) were taken and recorded to the nearest 0.1 cm and 0.1 g respectively. Fish samples were identified up to the species level according to Reed (1967), Holden et al. (1978), and Idodo-Umeh (2003).

Table 1. Summary of the morphometric features of the study stations.

Features	Station I	Station II	Station III	Station IV	Station V	Total
Volume (m^3)	176,396.17	111,380.13	2,105,824.00	59,648.28	1,960,555.54	4,413,804
Water level (Max.in m)	5.73	5.57	6.32	5.23	5.98	
Length (Max.in m)	117.28	265.91	980.00	131.85	694.97	2,250.01
Width (Max.in m)	173.65	75.20	340.00	86.50	471.75	
Shoreline (Max.in m)	428.20	664.78	2,254.00	350.21	2,333.43	6,030.62

Mean Width of the lake = 229.42

Area of lake = 516,197.2 m^2 (0.5162 km^2)

Data Analysis

Weight and number of fish species caught at the three stations (I, III & V) were analyzed using simple percentage, analysis of variance (ANOVA), LSD and the New Duncan Multiple Range Test (NDMRT). Weight and number of fish in the different stations as well as for the whole lake were analyzed graphically by pyramid of biomass and number to show abundance.

Biodiversity was analyzed using Mergalef's Index for species (taxa) richness (d), Shannon – Weiner index (H) for general diversity and the Evenness Index (E) of the community (Odum, 1971, Zar, 1984). Species dominance was determined using Ponderel Index of Benech et al. (1983) and Lauzanne (1983).

RESULTS

Catch data

A total of 1,394 fishes were caught during the sampling period. The number of fish caught monthly at the three stations are presented in Figure. 2. Generally more fishes were caught in the dry season than in the wet season. Similarly more fishes were caught in the first year of sampling than in the second year.

A total of 770 were caught at Station III, 171 at Station I and 453 at Station V. The highest catch of 188 individuals was in April 2002. Of this number, 155 were caught in Station III while the smallest catch of 12 was at Station I. Analysis of variance showed a significant difference among the monthly number of fish at the three stations of the lake, with $P<0.01$. DMRT showed that the monthly number of fish at Station I was significantly different from those of stations III and V, with $P<0.05$.

Weight Data

Weight distribution of fish in the lake is presented in Figure 3. A total biomass of 184,146 g of fish was caught during the study period. Of this, the highest biomass of 131,090 g or 71% was caught at Station III while the least biomass of 18,161 g or 10% was caught at Station I.

On a monthly basis the highest fish biomass of 34,352 g was caught in May 2002; while the least biomass was recorded for Station I in August 2001. ANOVA for the monthly weight of fish showed a significant difference $P<0.001$ among the stations. Using the NDMRT, Station III was significantly different for stations I and V ($P<0.05$).

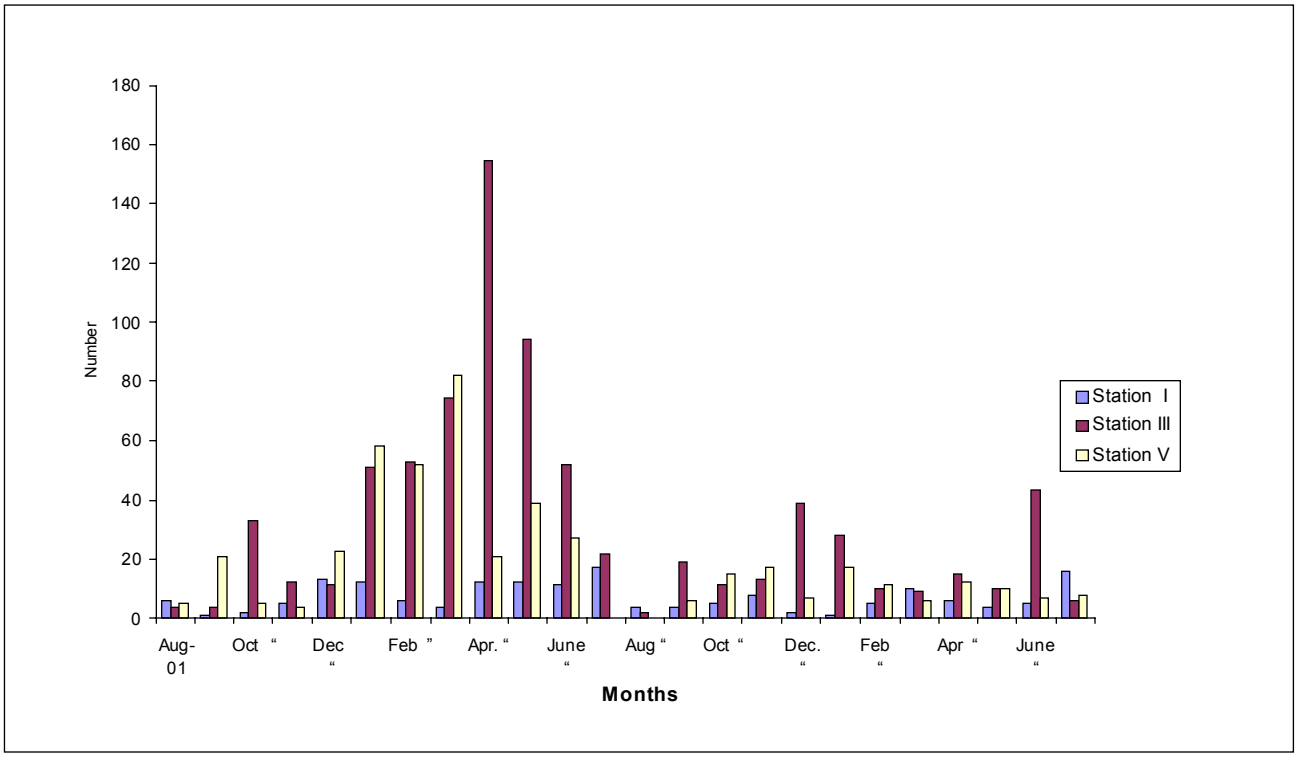

Figure 2. Monthly number of fish in lake.

Taxanomic checklist, Distribution and Abundance

Fifty-two taxa were collected in the course of the study. They comprised, *Clariidae (4), Osteoglossidae (1), Mochokidae (9), schilbeidae (2), Malapteruridae (1), Cyprinidae (2), Mormyridae (3), Gymnarchidae (1), Characidae (5), Hepsetidae (1), Citharinidae (1), Distichodontidae (3), Polypteridae (2), Lepidosirenidae (1), Bagridae (4) Centropomidae (1), Cichlidae (5), Channidae (2), Anabantidae (1), Pantodontidae (1), Notoptoridae (1)* and *Phractolaemidae (1)*. They are listed in Table 2.

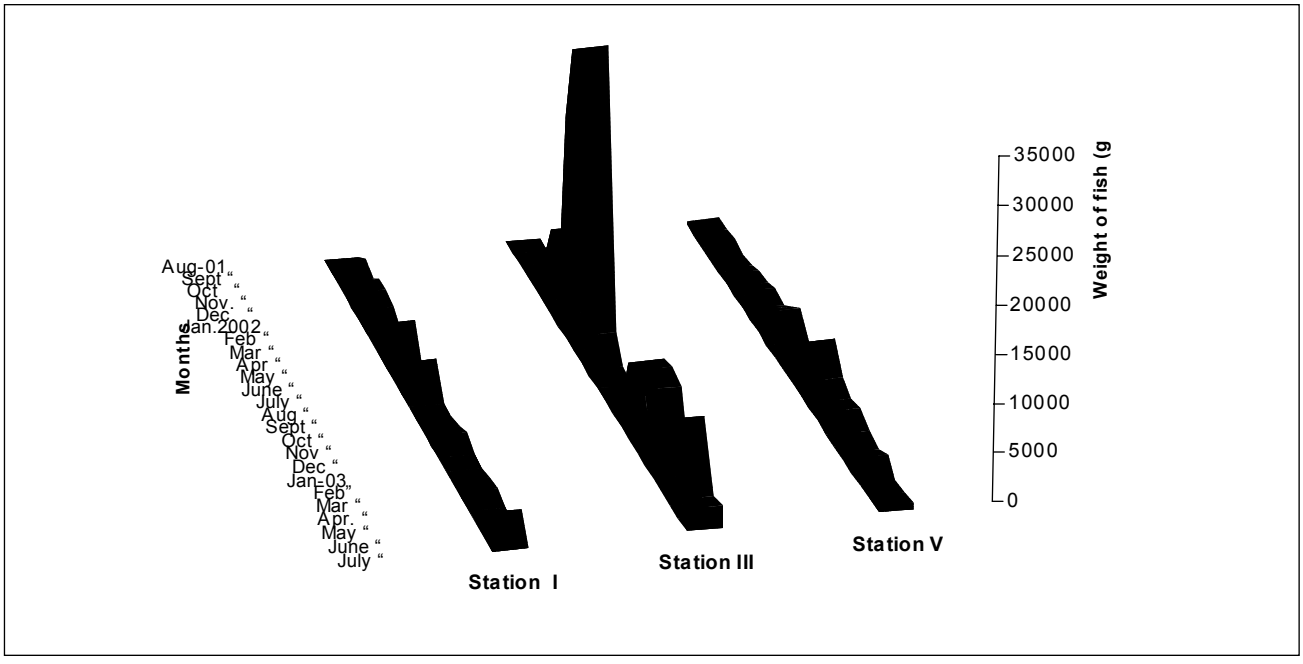

Figure 3. Monthly weight of fish (g) in lake.

The Family *Mochokidae* with a total of 391, out of the 1,394 individuals caught, is the most dominant in the population, followed by Family *Citharinidae,* Family *Clariidae,* Family *Cichlidae,* Family *Osteoglossidae,* Family *Bagridae,* Family *Characidae* up to the Family *Pantodontidae* which had 310, 116, 112, 75, 74, 61 and 2 individuals respectively.

When biomass was considered, the order of dominance changed with Family *Osteoglossidae* which had a total biomass of 37,028 g, becoming the most dominant, followed by Family *Clariidae,* Family *Citharinidae,* Family *Cichlidae* Family *Gymnachidae,* Family *Characidae,* Family *Mochokidae,* Family *Bagridae* and the last being Family *Pantodontidae.* These eight (8) families, had the following biomasses – 33,885 g, 28,064 g, 16,292 g, 13,212 g, 10,884 g, 9,931 g, 6,666 g and 16 g respectively.

The results of analysis for fish faunal diversity, indices for taxa richness and evenness are presented in Table 3.

Of the 52 taxa recorded in this study, 44 were at Station III, 22 at Station I and 33 at Station V. The taxa richness (d) was highest at Station III and least at Station I with values of 6.470 and 4.084 respectively. In terms of general diversity (H^1), Station I had the highest value of 2.758, followed by Station III (2.467). Evenness index (E^1), was highest (0.894) at Station 1 and least at Station III.

DISCUSSION

The fish community of Lake Ona was studied for 24 months and a total of 1,394 fishes were caught within this period. During the sampling period, no drastic change in the fish community was observed. It was likely that some rare events like feeding and spawning migrations of some species could have led to some species being missed from the catch. In spite of using a wide variety of fishing gear, this study could not account for the very small and early larval stages of some fish species.

A further limitation imposed on the study was the dry season predation enhanced by aggregation of fishes in a smaller volume of water (main channels of the lake) due to evaporation and drawdown of water. Because of these limitations, it seems justifiable to consider the fish community described here as an ecological entity in line with Benech (1983).

The non-significant difference observed in weight of fish caught at Station I and Station V ($P<0.05$), in spite of the fewer individuals caught at Station I, maybe due to the fact that they were of larger size compared to those of Station V.

It was observed that more fishes were caught in the dry season months with peak catches made in April and May. This trend may be due to the dry season drawdown of water, occasioned by the receding flood and supported by evaporation. These phenomena encouraged concentration of the fish in smaller volumes of water, and facilitated their being easily caught in large numbers. It was established in this study, that fish abundance correlated negatively, though not significantly, with water level in the lake ($P>0.05$).

The fish fauna of the lake were 1,394 individuals with a total biomass of 184 kg consisting of 22 families, 33 genera and 52 species. These figures compare favorably with the survey findings on some other water bodies. For the avoidance of doubt, Sydenham (1977) reported 85 species in the Ogun river, Beadle (1981) reported over 100 species in Lake Kainji and Tetsola (1988) reported 42 species in the up stream reaches of the Benin river.

Table 2. Taxonomic checklist, distribution and abundance of fish in Lake Ona.

Family	Genus	Species	I	II	III	Status
Clariidae	*Clarias*	*Clarias gariepinus*	10	11	5	***
		C. angularis	9	1	27	***
		C. submarginatus	12	8	16	***
	Heterobranchus	*Heterobranchus bidorsalis*	-	13	4	***
Osteoglossidae	*Heterotis*	*Heterotis niloticus*	26	44	5	***
Mochokidae	*Synodontis*	*Synodontis nigrita*	8	103	177	****
		S. eupterus	3	11	10	***
		S. sorex	-	1	-	*
		S. occillifer	-	5	-	*
		S. clarias	-	3	4	**
		S. filamentosus	-	8	1	**
		S. batensoda	2	2	10	***
	Hemisynodontis	*H. membranaceous*	19	11	8	***
		H .eupterus	4	-	-	*
Schilbeidae	*Schilbe*	*Schilbe mystus*	2	41	-	***
	Silurandon	*Silurandon auritus*	-	13	1	***
Malapteruridae	*Malapterurus*	*Malapterurus electricus*	-	2	1	*
Cyprinidae	*Labeo*	*Labeo coubie*	8	11	2	***
		L. senegalenis	-	13	3	***
Mormyridae	*Hyperopisus*	*Hyperopisus bebe*	-	-	1	*
	Mercusenius	*Mercusenius ihuysi*	-	-	8	**
	Gnathomemus	*Gnathomemus abadii*	1	1	-	*
Gymnarchidae	*Gymnarchus*	*Gymnarchus niloticus*	8	15	-	***
Characidae	*Hydrocynus*	*Hydrocynus vittatus*	-	14	3	***
	Alestes	*Alestes baremose*	-	20	6	***
		A .nurse	2	13	-	***
		A .dentex	-	-	1	*
		A.. leuciscus	-	2	-	*
Hepsetidae	*Hepsetus*	*Hepsetus odoe*	1	8	1	**
Citharinidae	*Citharinus*	*Citharinus citharinus*	9	187	112	****
Distichodontidae	*Distichodus*	*Distichodus rostratus*	-	8	2	**
		D. brevippinis	-	1	-	*
		D. engycephalus	-	25	-	*
Polypteridae	*Polypterus*	*Polypterus senegalenis*	-	10	-	**
	Calmoichthys	*Calmoichthys calabaricus*	2	2	-	*
Lepidosirenidae	*Protopterus*	*Protopterus annecens*	-	-	2	*
Bagridae	*Clarotes*	*Clarotes macrocephalus*	-	14	-	***
	Auchenoglanis	*Auchenoglanis occidentalis*	-	32	-	***
	Chrysichthys	*Chrysichthys nigrodigitatus*	-	15	-	***
	Bagrus	*Bagrus bayad*	-	13	-	**
Centropomidae	*Lates*	*Lates niloticus*	11	11	-	***
Cichlidae	*Hemichromis*	*Hemichromis fasciatus*	-	-	1	*
	Tilapia	*Tilapia zilli*	18	9	-	***
	Oreochromis	*Oreochromis niloticus*	11	45	19	***
	Sarotherodon	*Sarotherodon galilaeus*	-	7	-	*
		S. aureus	-	2	-	*
Channidae	*Channa*	*Channa obscura*	4	11	10	***
	Parachanna	*Parachanna africana*	1	1	3	*
Anabanitidae	*Ctenopoma*	*Ctenopoma kingsleyae*	-	-	3	*
Pantodontidae	*Pantodon*	*Pantodon buchholzi*	-	-	2	*
Notopteridae	*Xenomystus*	*Xenomystus nigri*	-	2	1	*
Phractolaemidae	*Phractolaemus*	*Phractolaemus ansorgei*	-	1	3	*

Table 3. Fish faunal diversity at study stations.

Parameters	Station I	Station III	Station V	Total
S = No of Taxa (S)	22	44	33	52
N=No.of Individuals (N)	171	770	453	1394
d = Taxa richness (d)	4.084	6.470	5.232	7.043
H^1= Shanon-Diversity (H^1)	2.758	2.467	2.151	2.957
E^1 = Evenness (E^1)	0.892	0.162	0.165	0.748

In line with Benech et al. (1983) and Lauzanne (1983), findings that any fish species having a Ponderal Index of 10% and above of the total number or biomass of the fish population is dominant. The Family *Mochokidae,* with a total of 391 out of the 1,394 individuals caught, is the most dominant in the population. On the basis of biomass however, the Family *Osteoglossidae,* with total value of 37,028 g, was established as the most dominant. The observed inverse trend implies that a fish species which is dominant in terms of number may not necessarily be dominant in terms of biomass and vice versa. The reason for this change in order of dominance is the possibility of one large individual of a particular family weighing more than 100 smaller individuals of another family. This agrees with a similar observation by Idodo-Umeh (1988)

It was observed in the present study, that the number of taxa (S), number of individuals (N) and taxa richness (d) were least at Station I, while diversity (H^1) and evenness (E^1) were highest at the same station. The explanation for this observed trend is that although the number of individual species caught at Station I were fewer, they were evenly distributed among the taxa. This was unlike the case of stations where the bulk of individuals caught belong to a few species. For example, Station V with 453 individuals of which 177 were *Synodontis nigrita* and 112 were *Citharinus citharus,* had the least evenness index (E^1) of 0.165. Similarly Station III with the highest individual catch of 770 and number of taxa of 44 is the least evenly distributed in having an evenness value of 0.162 and a diversity of 2.467. Here, out of the 770 individuals caught, 103 were *S. nigrita* and 187 were *C. citharus.* This agrees with the diversity and evenness model of Zar (1984).

The study of fish diversity in flood plains, rivers and lakes poses special problems as flooding drastically alters the faunal composition of the water bodies and the communities are always changing their species composition with time and water level. Fish are very mobile and the resident community in any area may be affected by the migratory activities connected with breeding and feeding (Lowe-McConnell, 1975). Thus diversity is a product of all dynamic, spatial and temporal changes affecting the community (Victor and Ogbeibu, 1985).

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REFERENCES

Aliu, B.S and O.J. Abolagba. 1994. The Nigeria observer, 9th August 1994. Vol. 8:143

Bagenal, T. 1978. Method for assessment of fish production in fresh water. IBP Handbook No.3. Blackwell Scientific Publications. Oxford London.

Beadle, L.C. 1981. The Inland Water of Tropical Africa. An Introduction to Tropical Limnology. Longman (publishers) London. 475pp.

Benech, V., J. Durand, and J. Quinsere. 1983. Fish Communities of Lake Chad and Associated River and

Floodplain – In: Carmouze, J.P., Durand, J.R, and Leve Que, C. (Editors). Lake Chad. Ecology and Productivity of Shallow Tropical Ecosystem. Dr. W. Junk (The Hague): 193-356

Diaz, I.S., A. Roa, C.B. Garcia, A. Asero, and G. Navas. 2000. Length–Weight Relationships of Demersal Fish from the Upper Continental Slope off Colombia. The ICLARM Quarterly. 23(2) 23-23.

Egborge, A.B.M. 1976. The effect of impoundment on the water chemistry of Lake Asejire. Nigeria Freshwater Biol., 9: 403-412.

Fagade, S.O. 1983. The Biology of *Chromidotilapia guntheri* from a small Lake, Arch. Hydrobiol. 97: 60-70.

Holden, M. and W. Reed. 1978. West African Freshwater Fish. West African Nature Handbooks. Longman Group Ltd. London.

Idodo–Umeh, G. 1988. Studies on the fish community of River Ase Bendel State with special emphasis on the food and feeding habits of *Citharinidae, Bagridae, Schilbeidae, Mochokidae*, Ph.D Thesis, University of Benin, Nigeria. 452pp.

Idodo–Umeh, G. 2003. Freshwater Fishes of Nigeria (Taxonomy, Ecological Notes, Diets and Utilization). Idodo–Umeh Publishers Nig. 232pp.

Imevbore, A.M.A. 1970. The Chemistry of the River Niger in the Kainji Reservoir Area. Arch. Hydrobiol. 67: 421-431.

Lauzanne, L. 1983. Tropical Relations of Fishes in Lake Chad Basin – In: Carmouze, J.P., Durand, J.R. and Leve Que, C. (Editors) Lake Chad. Ecology and productivity of a shallow tropical ecosystem. Dr. W. Junk (The Hague): 489-518

Lowe-McConnell, R.H. 1975. Fish Communities in Tropical Freshwaters, Longman,, London. 337pp.

Odum, E.P. 1971. Fundamentals of Ecology. 3rd edn. W. B. Saunders, London.

Ogbeibu, A.E. and R. Victor. 1989. The effects of road and bridge construction on the bank-root macrobenthic invertebrates of a southern Nigerian stream. Environ. Pollut., 58: 85-100.

Ogbeibu, A.E. and A.B.M. Egborge. 1995. Hydrobiological studies of water bodies in the Okomu forest reserve (Sanctuary) in Southern Nigeria: 1. Distribution and Diversity of the Invertebrate Fauna. Trop. Freshwater. Biol. 4: 1- 27.

Otobo, F.O. 1977. The Biology of the Clupeid fishes in Lake Kainji Nigeria. Ph.D Thesis, University of Ife,Ile-Ife, Nigeria.

Reed, W., J. Burchard, A.J. Hopson, J. Jones, and I. Yaro; 1967. Fish and Fisheries of Northern Nigeria. Ministry of Agriculture, Kaduna. 226pp.

Sydenham, D.H.J. 1977. The Qualitative Composition and Longitudinal Zonation of the Fish Fauna of the River Ogun, Western Nigeria. Rev. Zool. Afr., 91(4): 974-996.

Tetsola, E.A. 1988. Distribution and feeding relationships of the fishes of Warri River, Nigeria. Ph.D. Thesis, Uniben, Nigeria. 239pp.

Victor, R. and A.E. Ogbeibu. 1985. Macrobenthic invertebrates of a stream flowing through farmlands in Southern Nigeria. Environ. Pollut. (Ser.A). 39. 337-349.

Zar, J.H. 1984. Biostatistical Analysis, 2nd Edition. Prentice Hall Inc., New Jersey.

Zelibe, S.A.A. 1982. Ecology of Juvenile fishes at Eleiyele Lake in Ibadan. M.Sc. Thesis, University of Ibadan, Ibadan Nigeria.

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